

## Steinberg Technology Guide:

# Advanced Multiprocessor Support in Steinberg Cubase SL/SX 3.1 and 3.1 Nuendo

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Ever since the introduction of Cubase SX and Nuendo 2, Steinberg has been supporting multiprocessing in PC and Macintosh systems. Years of extensive research and development have gone into perfecting the VST audio engine for support of multiple processors. Not only has Steinberg continuously implemented custom optimization for the latest processor technologies; Cubase and Nuendo users also benefit from possibly the most advanced and efficient dynamic multiprocessing support available in any digital audio workstation or music production system available today.

In a multiprocessor system, both application-specific and system-related tasks need to be assigned to the available processors. In the past, some digital audio workstations and music production programs directly assigned specific processes (like audio recording and playback, mixing, plug-ins and instruments) to dedicated processors. Once a single processor is maxed out with a specific task, the entire system is maxed out while remaining processor capacity remains unused. In Steinberg host applications Cubase and Nuendo, processor tasks are dynamically allocated. This results in the most efficient processor usage and delivers overall better performance compared to applications with a static processor allocation.

Multiprocessing not only delivers significant performance boosts for VST Effects Plug-ins and VST Instruments, it also affects many areas of audio playback and recording, such as realtime stretching and pitch-shifting (AudioWarp) and realtime crossfades. This is why increased performance is noticeable throughout the entire system, not only in terms of plug-in count or instrument count. This is another result of Steinberg's advanced dynamic processor allocation technology.

With recent advances in processor technology, users are faced with a multitude of different systems and solutions. In order to better understand these different solutions, here's a quick overview:

**1. Mac OSX/Power PC:** Apple just recently updated the entire G5 Power Macintosh product line to DualCore PowerPC processors. In addition to previous G5 Power Macintosh systems with single or dual processors, Cubase 3.1 and Nuendo 3.1 fully support the newest G5 models and utilize all available processor cores with dynamic multiprocessing. In addition, Cubase and Nuendo Mac users also benefit from G4 and G5 processor optimization. First tests of a G5 Quad system show a significant performance gain over single-core systems. With the announced switch to Intel processors in 2006, Apple can be expected to utilize dual-core technology as well, although no official announcement has been made at the time of this writing.

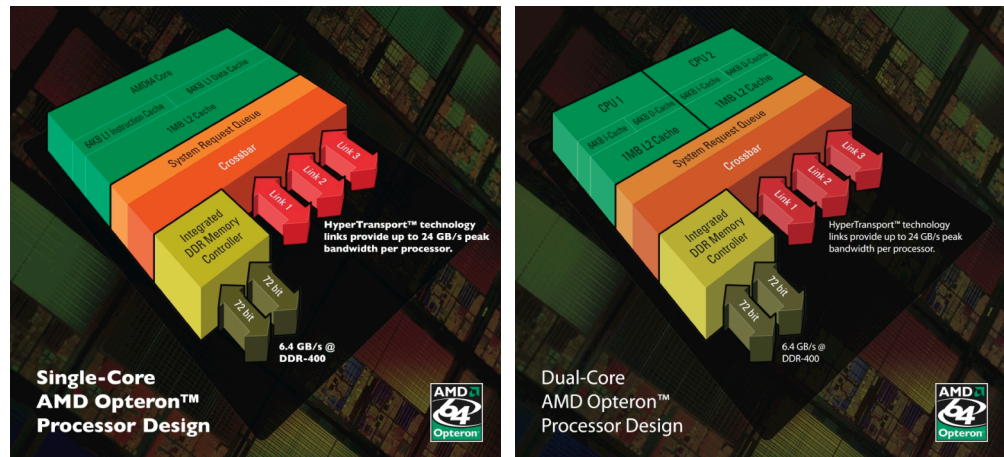
**2. PC (Intel and AMD):** Ever since the early days of Cubase VST, Steinberg has implemented processor-specific optimization in order to get the best performance out of these systems. In terms of multiprocessing, users are confronted with different possible solutions, which are often misunderstood or confusing.

**Single processor systems** come in versions with or without Hyperthreading. Hyperthreading is available on certain Intel processors. It is a technology to run parallel tasks on a single processor, thereby improving processor performance. While not as effective as true multiprocessing or dual core processors, Hyperthreading delivers a noticeable but marginal performance gain in Cubase or Nuendo. Performance gain is typically 5-15%, depending on the system configuration and project. However, it should be turned off in dual-processor or dual-core systems when used with Cubase or Nuendo.

**Dual processor systems** are computers equipped with two physical processors. Cubase and Nuendo users of such systems fully benefit from all processor-specific optimization plus dynamic multiprocessor support. The performance gain is significant, essentially doubling the available resources.

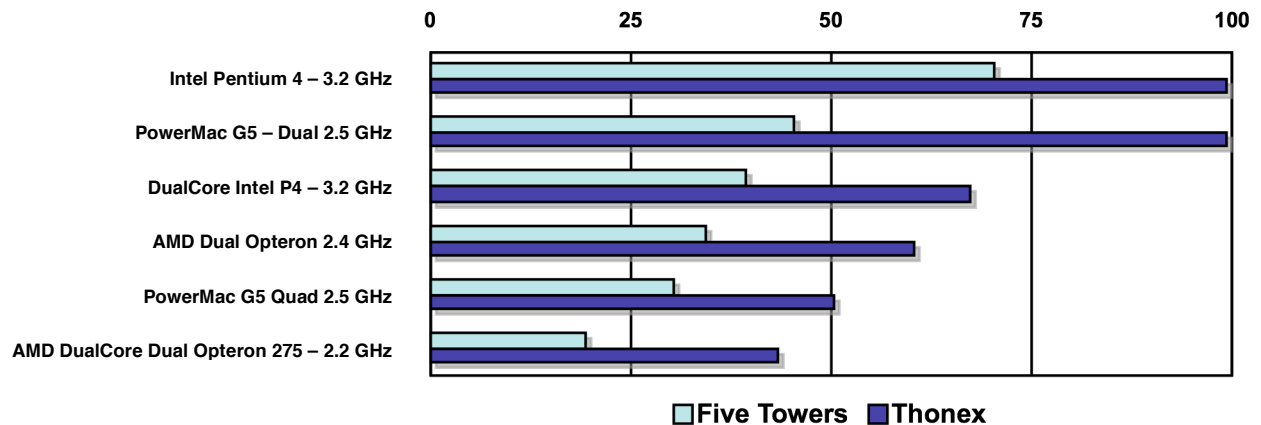
**Quad (or more) processor systems:** Cubase and Nuendo version 3.1 or higher include support for more than two physical processors. Such systems benefit from all processor and dynamic multiprocessor support in the same way as dual processor systems. Theoretically, Cubase and Nuendo users could use supercomputers with even more physical processors running in parallel. However, these six-digit \$\$\$ systems probably exceed the budget of most people and are usually found in research labs and big corporations. Also, they have never been tested with Cubase Nuendo.

**Dual-core systems:** both AMD and Intel are now offering dual-core processor systems. A dual-core CPU combines two independent processors and their respective caches and cache controllers onto a single silicon chip, or integrated circuit. The performance result is comparable to a dual processor system. Dual core processor technology can be combined with multi processor systems - resulting in an even higher performance. AMD already offers solutions combining two dual core processors in a single system to form a quad-core system with amazing performance. Initial tests with Nuendo on such a system confirm that Steinberg's VST system fully benefits from such processor configurations resulting in massive performance boosts compared to a single-processor system.



Comparison between Single-Core and Dual-Core processor design<sup>1</sup>

The following are some first results from early benchmark tests done on various Intel or AMD equipped computers running Cubase SX 3.1 or Nuendo 3.1. Shown here is the actual CPU load measured on different single and dual-processor systems. **Lower values are better.**



Benchmarks using two typical Cubase Projects using identical I/O hardware with a buffer-size of 256 samples<sup>2</sup>, except for the PowerMac G5 Quad which has been tested with Firewire I/O hardware.

In order to make the most out of a system, Cubase and Nuendo users should keep the following recommendations in mind when optimizing their systems:

1. Hyperthreading should be used in single-processor systems only. When running a multiprocessor or dual-core system, Hyperthreading should be deactivated or it may interfere with the multiple physical core architecture.

Disabling Hyperthreading needs to be done in the PC's BIOS and Windows XP should be (re)-installed afterwards. [Depending on the previous on/off state of Hyperthreading, a different hardware abstraction layer might be used by Windows XP. Simply turning off Hyperthreading without re-installing the operating system could result in Windows using the wrong hardware abstraction layer.]

2. Both dual-core and multiprocessor systems are relatively new to the market and detailed performance tests have yet to be done. However, initial tests with AMD, Intel and IBM systems have shown no problems and performance gains are as expected. In any case, when purchasing a new multiprocessor or dual-core system, the user should make sure the operating system is configured properly. Steinberg cannot provide or maintain a list of compatible or supported systems. Therefore, ideally the system should be tested with Cubase or Nuendo first. Please also refer to Steinberg's User Forums at [www.cubase.net](http://www.cubase.net) and [www.nuendo.com](http://www.nuendo.com) for up-to-date information and discussions on system compatibility and real-world performance.

3. Since multi-processor or multi-core performance affects many different areas of the software - such as audio playback, AudioWarp, crossfades, VST Plug-ins, and VST Instruments - and the operating system, actual results vary from system to system. One project may consist of many simultaneous audio tracks with or without AudioWarp, while another project might consist mostly of MIDI tracks assigned to VST Instruments. Simultaneously, there are always system-related CPU tasks, which add to the program-specific processor tasks. Therefore, any performance test will always be valid for the specific system they're run on.

Here are some links to further information related to multi-processing topics:

<http://multicore.amd.com/Global/>

[http://www.amd.com/us-en/Processors/ProductInformation/0,,30\\_118\\_8826,00.html](http://www.amd.com/us-en/Processors/ProductInformation/0,,30_118_8826,00.html)

<http://developer.intel.com/products/processor/xeon/index.htm>

<http://www.intel.com/technology/computing/dual-core/>

<http://www.apple.com/g5processor/>

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<sup>1</sup> Graphics used by permission of AMD. All rights reserved.

<sup>2</sup>"Thonex" Test project provided by Andrew Keresztes. [[http://www.andrewkmusic.com/filearea/Thonex\\_Test.npr](http://www.andrewkmusic.com/filearea/Thonex_Test.npr).] Andrew is a Film & TV composer in Los Angeles and the "Thonex Test" has no bearing on his compositional abilities. [<http://www.andrewkmusic.com>]

"Five Towers" test project provided by Luigi Moar [<http://www.moar.net/cubasetest/>] You can contact Luigi at: [<http://www.moar.net/fivetowers/contattaci.shtml>]